& Gessler, 1946), which they used to cut thin sections from rubber, acrylic resins, and nylon.[23] Could this be made to work for biological specimens? Claude, together with Fullam, began to explore this in 1944–5, reporting that

> if the cutting blade is mounted on a disc and rotated at 50,000 r.p.m. then sections can be made less than 1 μ in thickness. It has been necessary to modify the usual techniques for preparation of the tissues. The only satisfactory fixative so far found is a dilute solution of osmic acid brought rapidly into contact with the cell by perfusion. A new type of embedding material has been used which will sublime at reduced pressure leaving the section ready for electron microscopy free from complicating foreign matter. (Annual Report, 1944–5, p. 76)

These slices, however, were still too thick for electron microscopy. In the Annual Report of his laboratory the following year, Claude indicated partial progress in creating still thinner slices: "During the year an experimental microtome, designed to give sections of 0.1 μ has been built which gives promise of achieving the objective. An entirely satisfactory blade has not yet been found and further investigation of methods of fixation and embedding of tissues to render them suitable for thin sections is in progress" (p. 86).[24] Although Claude and Fullam (1946) published some of the micrographs from their research, the pictures revealed distortions that were due to an insufficiently hard embedding agent and an insufficiently sharp blade.

Subsequently Claude collaborated with Joseph Blum, an engineer with the Rockefeller Institute, to develop a low-speed microtome in which the specimen passed the knife only once as it revolved on a disc or wheel, thereby reducing the potential for tearing the specimen. The microtome also included a liquid-filled trough mounted next to the knife into which the newly cut sections could float (see Palade, 1971). But, as Claude reported in his Harvey Lecture (1948), that did not solve the problems with fixation and embedding or of needing a sufficiently sharp blade for cutting. The embedding problems were largely resolved by Sanford Newman, Emil Borysko, and Max

[23] Rasmussen reported, "This ultramicrotome was first offered commercially, with an advertisement suggesting that purchasers were making a safe investment because the device could easily be converted into an ultracentrifuge. The section quality was not remarkably better than that delivered by slower microtomes, and the clouds of flying downlike sections it produced had to be collected with a fine butterfly net" (1997, p. 112).

[24] Two other groups, Daniel Pease and Richard Baker at the University of Southern California, and L. H. Bretschneider in the Netherlands, were working without knowledge of Claude and Fullam's work due to a two-year delay in the appearance of his Harvey Lecture. Pease and Baker adapted a standard Spencer 820 microtome while Bretschneider adapted the Cambridge Rocking Microtome. Both groups ultimately faced the same problem as Claude – the lack of good embedding and adequate knives. (See Pease & Porter, 1981.)